

SPECIAL FORECASTS AND WARNINGS—WEATHER AND CROPS.

WEATHER WARNINGS.

By H. C. FRANKENFIELD, Supervising Forecaster.

[Dated: Weather Bureau, Washington, Mar. 15, 1919.]

Storm warnings.—There was no occasion for special forecasts until the evening of the 9th, at which time a western disturbance had reached the North Carolina coast with a northeastward movement. At the same time a disturbance was approaching Bermuda from the southward, and advisory warnings were issued for strong north winds at sea north of the Virginia capes. Strong winds and gales occurred as forecast. There was also a disturbance of marked intensity over Alberta moving southeastward, and warnings of strong northeast winds with snow or rain were sent to open ports on Lake Michigan. This disturbance moved due eastward with decreasing intensity, and no strong winds occurred.

On the night of the 12th a severe disturbance from the north Pacific was central over the Texas Panhandle with general low pressure east of the Rocky Mountains, and at 10 p. m. warnings were ordered on the Gulf coast from Bay St. Louis, Miss., to Cedar Keys, Fla., for strong southeast winds on the following day. On the morning of the 13th the storm was over northwestern Missouri, with a barometer reading of 28.90 inches at Kansas City, and fresh southerly gales were blowing over northeastern Gulf of Mexico. Southwest warnings were then ordered at Tampa, Fla., and along the Atlantic coast from Jupiter, Fla., to Fort Monroe, Va. Strong northeast to north gales, with snow and lower temperatures were also forecast for the Upper Lake Region, and strong shifting winds for the Ohio Valley, Tennessee, and the Lower Lake Region. At 5 p. m. southeast storm warnings were ordered along the Atlantic coast north of Fort Monroe, and the warnings along the Gulf coast from Bay St. Louis to Cedar Keys were changed to northwest. Winds occurred as forecast over all districts, except along the Maine coast, the disturbance having diminished in intensity, and divided after leaving northern Illinois. On the night of the 14th, with a secondary disturbance off the New Jersey coast, northeast storm warnings were displayed at Eastport, Me., but only fresh winds occurred, notwithstanding the very low pressure.

On the morning of the 15th, when the steamship *George Washington* was leaving France with the President of the United States on board, the following special message was sent to the Navy Department, Washington, D. C.:

Strong shifting winds and gales and stormy weather will prevail over the entire North Atlantic Ocean for the next several days. Marked depression off the New England coast moving northeastward, and severe storm near the Azores with barometer this morning 28.90 inches and maximum wind velocity of 84 miles an hour from south.

From reports received later it appears that this forecast was fully verified.

As abnormally low pressure continued along the North Atlantic coast, with a rapid rise over the interior, northwest storm warnings were ordered at 5 p. m. from Delaware Breakwater, Del., to Newburyport, Mass., for strong west and northwest winds, snow, and colder weather. These warnings were fully verified as to wind and temperature, New York City, and Block Island, R. I., reporting maximum wind velocities of 64 and 56 miles an hour, respectively, from the northwest, but there was no snow south of New England.

A disturbance of the "Southwestern" type was central on the evening of the 19th over northern Arizona, moving

east-northeastward with increasing intensity, and small craft warnings for fresh to moderately strong southeast winds were ordered displayed at 8 a. m. of the 20th along the Middle Gulf coast. The winds occurred as forecast, and at 11 a. m. of the 20th, with the disturbance central over southeastern Kansas, small-craft warnings were ordered displayed at Tampa, Fla., and along the South Atlantic coast from Jacksonville to Cape Henry for fresh to moderately strong east and southeast winds. However, the disturbance rapidly disintegrated during the 20th, and only local fresh winds occurred.

Another disturbance of similar origin was over Lake Huron on the evening of the 20th with rapid northeastward movement and increasing intensity, and at 10.30 p. m. southwest storm warnings were ordered from Delaware Breakwater, Del., to Portland, Me. At 11 a. m. of the 23d southeast warnings were also ordered east of Portland. Strong winds occurred as forecast, Eastport, Me., reporting a wind velocity of 56 miles an hour from the east.

Still another disturbance, from the North Pacific, really a redevelopment in the rear of a more moderate primary disturbance, was central on the morning of the 25th over southern Louisiana, with a strong and cold high area to the northwestward, and at noon northwest storm warnings were ordered from Bay St. Louis, Miss., to Carrabelle, Fla., for shifting winds becoming northwest and strong, with rapidly-falling temperature. Advisory warnings for fresh to moderately strong northwest winds had previously been issued to open ports on Lake Michigan, the primary disturbance at the time being a short distance northeast of Lake Superior. Again strong winds occurred as forecast.

On the evening of the 25th the secondary disturbance was central over extreme northeastern Florida, with another secondary over southeastern Virginia, and at 10.30 p. m. northwest storm warnings were ordered along the Atlantic coast from Jacksonville, Fla., to Nantucket, Mass. The primary disturbance was over eastern Ontario at this time, and on the following day strong winds and gales occurred as far north as the Massachusetts coast. On the morning of the 26th northwest warnings were ordered for the eastern Maine coast, but only fresh winds followed, the storm center having moved northeastward at some distance off the coast.

Again, on the evening of the 27th, another disturbance from the North Pacific was central over Oklahoma, with a cold high area to the northward, and southeast warnings were ordered on the Gulf coast from Bay St. Louis, Miss., to Carrabelle, Fla. Advisory warnings of snow, cold weather, and strong east and northeast winds were also sent to open ports on Lake Michigan. The forecast was fully verified as to Lake Michigan, but failed on the Gulf coast owing to the rapid northeastward movement of the storm center.

On the morning of the 28th with the storm central in marked form over extreme eastern Iowa, strong winds were forecast for the Ohio Valley and the entire lake region, and gales occurred generally during the day and night. At 5 p. m. southwest storm warnings were ordered along the Atlantic coast from Wilmington, N. C., to Portland, Me., but as the storm rapidly diminished in

intensity during the night there were no strong winds, except between Delaware Breakwater, Del., and Block Island, R. I.

There were no storms without warnings.

Cold wave and frost warnings.—Frost warnings were issued for some portions of the Southern States on the 4th, 6th, 9th, 10th, 15th, 16th, 17th, and 23d. All warnings were verified, except those of the 17th for central and northern Florida, and those of the 23d for Alabama, southern Georgia, and northern Florida. The frosts in Florida on the 10th and 11th were severe.

The first cold-wave warning of the month was issued on the 4th for portions of Michigan, and was only partially verified, both as to amount of fall in temperature and the lowest temperatures reached. The next warning was issued at 2 p. m. of the 9th for southern Alabama, southern Georgia, and extreme northwestern Florida, and a moderate cold wave occurred on the following morning. On the evening of the 24th warnings were issued for a cold wave within 36 hours over Michigan and northern Indiana, and extended on the following morning over the Lake Region, the Ohio and Lower Mississippi valleys, the East Gulf and the South Atlantic States, those in the South to occur within 48 hours. These warnings were well verified except in the South, no freezing temperatures occurring east of Alabama except in northwestern Georgia. On the evening of the 25th and the morning of the 26th the cold-wave warnings were extended over the Middle Atlantic States and New England, but they were not verified owing to the rapid eastward movement of one of the numerous western disturbances.

On the evening of the 27th and morning of the 28th cold-wave warnings were issued for the Lake Region, the Ohio Valley, and the East Gulf States, and in the evening for the Middle and South Atlantic States. These warnings also failed of verification, although there was a decided fall in temperature, except in the South Atlantic States.

No cold waves occurred without warning except local ones on the 9th, at Sault Ste. Marie, Mich., and Elkins, W. Va.

WARNINGS: OTHER DISTRICTS.

New Orleans, La., forecast district.—On the morning of February 3, the barometer was low over the Mississippi Valley. There was also a moderate but well-defined cyclonic movement of the atmosphere in the West Gulf region and an area of high pressure attended by low temperatures over the eastern Rocky Mountain region, the Missouri Valley, and the Plains States. Cold-wave warnings were issued for central and eastern Oklahoma, east Texas, except the immediate coast, northwest Louisiana, and western Arkansas, based on the low from the West Gulf region moving out and the high-pressure area dropping southward into that region. The low pressure did not move out of the West Gulf region and the cold wave was justified only over the extreme northern portion of the district.

An area of low pressure over the interior of Texas, with an area of high pressure and low temperatures over the Missouri Valley and the Plains States on the p. m. map of February 6 indicated cold waves in Oklahoma, Arkansas, the interior of east Texas, and northwest Louisiana, and warnings ordered for these areas failed of verification because of an area of low pressure which, reports the following morning showed, centered in the vicinity of Monterey, Mexico.

Low temperatures accompanying an area of high pressure, having its crest over the northern Rocky Mountain region, with an area of low pressure over the southern Rocky Mountain region on the evening of February 23 indicated that a cold wave would over-spread the greater portion of this district; cold-wave warnings were ordered at 9:30 p. m., February 23, for Oklahoma, the Texas Panhandle, and extreme northwestern Arkansas, and were repeated at 9:45 a. m. on the 24th, and extended at 1:00 p. m. over Arkansas, northwestern Louisiana, and the eastern portion of east Texas, and at night to the Louisianian coast. The cold-wave warnings were justified.

Cold-wave warnings were issued at 9:30 p. m. on the 27th for Oklahoma and extreme northwest Arkansas, and at 10:00 a. m. on the 28th for the remainder of Arkansas, Louisiana, and Houston and Port Arthur, Tex.; the warnings were justified.

No general cold waves occurred without warnings.

Small-craft warnings were issued on February 12 and 19 for the Texas coast, and storm warnings were issued for the Texas and the Louisiana coasts on the 12th and 25th; the warnings were justified.

No general storm occurred without warnings.

Live-stock warnings were distributed on the 23d, 24th, 25th, 27th, and 28th.

Fire-weather warnings were distributed to Oklahoma and Arkansas on the 27th.—*I. M. Cline.*

Chicago, Ill., forecast district.—The first cold-wave warnings of the month were issued on the morning of February 3, and covered north-central Iowa, extreme eastern Minnesota, and western and northern Wisconsin, and were extended during the afternoon to include the balance of Wisconsin, and Dubuque and Davenport, Iowa. Practically all of these warnings were verified.

Cold-wave warnings were not issued again during the month until the morning of the 23d, when a marked cold high area appeared in the British Northwest. Warnings were then sent to southeastern Montana, east and central Wyoming, and the western portions of North and South Dakota and Nebraska. The evening of the same day warnings were extended eastward as far as Minnesota and northwestern Iowa, and during the 24th, eastward and southward, including the entire district. Advises were also sent to the stock interests of Wyoming, South Dakota, Nebraska, and western Kansas during the eastward movement of this cold wave. These warnings were for the most part fully verified, although the verifying limit was not reached at some points in the southwestern portion of the district.

From the 24th to the close of the month intense cold prevailed in Montana, the Dakotas, and Minnesota, but the rapid return to warmer weather over the southern and eastern portions of the district on the 27th, under the influence of a disturbance moving southeastward across the Middle Rockies and thence northeastward to the Lake region necessitated the issuing of cold-wave warnings from southern Wyoming to the eastern limits of the district. With the exception of southern Wyoming, all these warnings were verified. The stock interests of South Dakota, Nebraska, and Kansas were fully advised of the approach of this cold wave which caused fresh to strong northerly winds, with snow, in the Southern Plain States.—*Ernest H. Haines.*

Denver, Colo., forecast district.—The month was notable for the large number of North Pacific lows, several of which developed into storms of such marked character

as to require special warnings. The low that appeared on the North Pacific coast on the 25th became one of the most severe storms of recent years in the central portion of the district.

On February 1 a disturbance of marked intensity was central in southern Nevada, and warnings of heavy snow in northern Arizona, southwest Colorado, and northwest New Mexico and high winds in Utah and northern Arizona were issued. Several inches of snow fell over the area covered by the warnings. Press dispatches from Flagstaff, Ariz., stated:

A cold wind was causing drifting, which is said to be seriously interfering with train movements. Reports indicate that all of northern Arizona is in the grip of weather approximating blizzard conditions.

On the 11th a disturbance of considerable intensity was central in northern Nevada and warnings of strong westerly winds were issued for the western part of the district. By 8 p. m. the storm occupied the middle Rocky Mountain region and warnings of strong westerly winds were extended to New Mexico. It crossed the Divide by 8 a. m. of the 12th and the warnings were extended to the remainder of the district. During the passage of the storm across the district fresh to strong winds were general. The highest velocity reported was 60 miles an hour from the west in southern New Mexico. A disturbance developed in western Utah on the 17th, moved slowly eastward and reached western New Mexico on the morning of the 19th, when warnings of heavy snowfall in southern Colorado and northern New Mexico were issued. Many stations in southern Colorado reported several inches of snow. At Trinidad the snowfall was 8.8 inches. A storm of unusual intensity appeared on the North Pacific coast on the 25th. On the morning of the 26th the barometer reading at Tatoosh Island was 29.06 inches and the pressure was decreasing rapidly in the Plateau region. Warnings of strong southerly winds were issued on the 26th for Utah, New Mexico, and Arizona, and on the 27th for the entire district. At 8 a. m. on the 27th the storm was over northwest Colorado, with increased intensity, while an anticyclonic area occupied the Canadian border States from Montana eastward to Wisconsin and the pressure was rising in the Plateau region. The wind attained a velocity of 64 miles from the south at Modena and 52 miles per hour at Salt Lake City on the 26th and 30 to 56 miles in New Mexico and northern Arizona on the 27th. Snow slides were reported in several localities in the mountain districts and railroad officials reported the worst week experienced in years. Livestock warnings were issued for parts of Colorado on the 2d, 24th, and 27th and for northeast New Mexico on the 27th, and cold wave warnings in eastern Colorado on the 24th and in Colorado, north New Mex-

ico, north Arizona, and southwest Utah on the 27th. The warnings were generally fully justified.—*Frederick W. Brist.*

San Francisco, Calif., forecast district.—Stormy weather was the rule rather than the exception in this district during February. Storm warnings were ordered on 14 days for some portion of the North Pacific coast; small craft warnings were displayed on four occasions, and three live-stock warnings were issued. Frost warnings were issued for some portion of California on 18 days. Most of the warnings were justified, although neither the storms nor the frosts were of unusual severity.

On February 8 about 10 miles south of Bellingham six men were washed overboard and drowned from the cannery tender *Uwanta*. The *Uwanta* was near the center of the bay, where the waves were unusually high, when she raced into the trough of a big wave and careened so far to the leeward as to spill five men into the sea. The captain, in endeavoring to rescue one of them, jumped into the water and was also drowned. Warnings for the storm were ordered at Bellingham at 6:40 p. m., February 7.

One of the most freakish storms on record developed suddenly over Vancouver Island on the morning of the 4th. A barometer reading of 29.00 inches was reported that day at 5 a. m. at Triangle Island. During this storm a maximum wind velocity of 80 miles from the southwest occurred at Tatoosh Island. The weather map the evening before did not indicate the proximity of such high winds and no warnings were issued. Our observer at Tatoosh reported there was not the slightest local indication of a violent blow 8 hours before the maximum velocity was reached. The storm disappeared almost as rapidly as it appeared, and the evening weather chart the same day showed scarcely a trace of it.

In a letter from the H. J. Dangberg Land & Live Stock Co., of Minden, Nev., dated February 25, 1919, the secretary of the company stated, "The weather reports (live-stock warnings) you have been sending us at different times are greatly appreciated and they have been of valuable assistance in several instances."

At Sacramento, Calif., there were six light and four heavy frosts, and at Fresno, Calif., the numbers were four and three, respectively. At both of these stations the minimum temperature for February was 33°, from roof exposures, while at Pomona, in the citrus district of southern California, the minimum temperature was 32°, or lower, on 14 days, with instruments exposed about 5 feet above the ground. Verifications of frost forecasts under these conditions are unsatisfactory, but it is believed most of those issued were verified, although some few were decided failures.—*E. A. Beals.*

RIVERS AND FLOODS, FEBRUARY, 1919.

By ALFRED J. HENRY, Meteorologist in Charge.

There were no severe floods during the month. Flood stages due to moderate rains occurred in the South and in northern California as indicated in the paragraphs below.

The high water in the Santee River in South Carolina that was in progress at the end of January had fallen below flood stages by the 12th, but moderate rain on the 14th caused it to pass the flood stage again by the 16th.

The Pearl River at Jackson, Miss., was at flood stage from the 7th to the 9th.

General rains of moderate intensity in the South Atlantic and East Gulf States from the 20th to the 26th caused most of the rivers in these districts to slightly

exceed flood stages during the last week of the month. But little damage was suffered owing to timely warnings.

Moderate to heavy rains during the second week of the month caused a sharp rise in the Sacramento River. Owing to the reclamation of Sutter Basin, the water which flowed through Moulton Break into Butte Slough was forced to the north and east of Sutter Basin and it spread over several thousand acres, causing damage estimated at several hundred thousand dollars.

The Willamette River at Eugene and Oregon City, Oreg., was in slight flood on the 10th and 12th. The usual tabular matter follows: